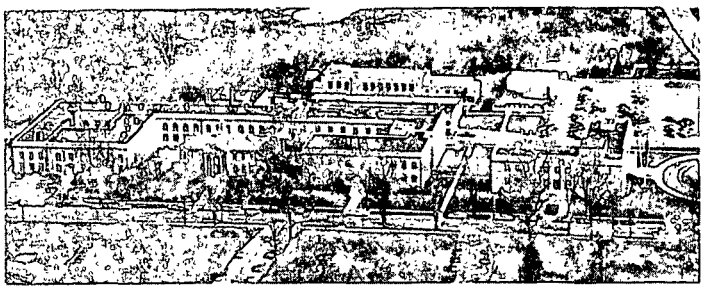

THE INSTITUTE OF PAPER CHEMISTRY, APPLETON, WISCONSIN

RELATIONSHIP BETWEEN CORE PERFORMANCE AND THE PROPERTIES OF THE CORE STOCK

Project 2906

Report One

A Preliminary Report

to

FIBRE TUBE AND CORE RESEARCH GROUP

September 30, 1970

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

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INTRODUCTION

This investigation is directed to the study of (a) tube and core performance under various stress environments encountered in use, and (b) the development of relationships between tube and core performance and the properties of the base stocks and dimensions.

Information developed in these studies should be helpful in (a) identifying properties of the core stock that are important to end-use performance and, hence, to board manufacture, (b) design of the tube or core in respect to selection of core stocks and dimensions for various end uses, and (c) prediction of the performance of the tube or core in a variety of end-use environments based on a knowledge of the properties of the base stock and dimensions.

The present study is divided into two phases. In the first phase, twenty-one samples of core stock were obtained from the participating companies and made up into 3-inch inside diameter cores for the purpose of determining the effect of material on core performance. The evaluation of the cores and core stocks for this phase of the study is nearly complete. This interim report summarizes the results to date. Analysis of relationships between core performance and core stock properties will be initiated on completion of testing.

In the second phase, two samples of core stock will be utilized to study the effect of core dimensions – diameter and wall thickness – on core performance. The core stocks to be used in this phase are in transit.

All cores were wound on a 3.015-inch mandrel. The cores were made using eight plies of 0.030-inch stock, or ten plies of 0.025-inch stock. Inner and outer liners (0.014-inch) were used for all runs except for two special runs made without liners – Runs 2-2 and 11-2. In the latter case, one additional 0.030-inch ply was used in place of the two liner plies.

All cores were fabricated using PVA adhesive, although it was necessary to vary the solid contents for certain of the runs.

Moisture content samples were obtained at the end of each run from three of the ribbon reels.

Approximately sixty to seventy 80-inch cores were obtained for each run.

CONDITIONING

The cores were preconditioned at 25% R.H. and 73°F. for at least ten days and then conditioned at 73°F. and 50 ± 2% R.H. for at least ten days prior to test. Several core specimens were weighed in each atmosphere at periodic intervals to check the adequacy of the above conditioning times.

The core stock and liner samples were preconditioned at least twenty-four hours at 25% R.H. and 73°F. and conditioned for at least forty-eight hours at 73°F., 50 ± 2% prior to test.

TABLE I

TESTS ON CORES

	Test	No. of Tests	Method
1.	Side-to-side crush[b]	16	NFCTA T-108
2.	Axial (end-to-end) crush[c]	16	NFCTA CT-107
3.	End supported beam strength[d]		
	(a) 36-inch span	8	NFCTA T-114
	(b) 72-inch span	8	NFCTA T-114
4.	Wall thickness, in.	32	NFCTA CT-101, Method B
5.	Inside diameter, in.	8	NFCTA CT-102, Method A
6.	Outside diameter	--[a]	NFCTA CT-103, Method C
7.	Moisture content (at time of test)	3	NFCTA CT-111
8.	Weight (4-inch long specimen at time of test)	16	
9.	Torque strength	5	NFCTA T-116

[a] Calculated from inside diameter and wall thickness.

[b] Test rate was 2 inches per minute.

[c] Test rate was 0.2 inch per minute.

[d] Test rate was 2 inches per minute.

DISCUSSION OF RESULTS

The core test results are summarized in Table III for each of the twenty-one core stock samples fabricated into cores. The maximum and minimum values for side crush, axial crush, and beam strength are noted below:

	Maximum	Minimum
Side crush, lb./in.	79.8 (Run 2)	38.8 (Run 21)
Axial crush, lb.	4277 (Run 6)	2454 (Run 20)
Beam strength, lb.,		
First peak	438 (Run 6)	245 (Run 20)
Maximum load	485 (Run 6)	274 (Run 20)

Thus, the core performances vary over a wide range depending on the core stock used. This should be helpful in analyzing the data to determine relationships between core performance and core stock properties.

Because of the costs involved in constructing the torque test apparatus specified in NFCTA T-116, the Institute has arranged to have these tests conducted by an outside concern. The tests are in progress at present.

Beam tests using a 72-inch span are in progress. These tests will be completed in the near future.

For two of the runs, cores were fabricated with and without inner and outer liners. When made without liners, an additional ply of core stock was inserted in place of the liners. A comparison of the effect of liners on core performance may be found in Table IV. In general, the cores made without liners exhibited slightly lower side, axial, and beam strength.

The test results on the core stock samples are tabulated in Table V. The core stock tests are complete except for the tensile load-elongation results

TABLE IV

COMPARISON OF RESULTS FOR CORES MADE WITH AND WITHOUT LINERS

Test Property	Run 2			Run 11		
	With Liner	Without Liner	Diff., %[a]	With Liner	Without Liner	Diff., %[a]
Side crush, lb./in.	79.8	77.2	- 3.3	45.3	43.6	- 3.8
Axial crush, lb.	4135	4009	- 3.0	2867	2666	- 7.0
Beam strength, lb.[b]	458	450	- 1.7	346	333	- 3.8
Inside diameter, in.	3.0140	3.0177	+ 0.1	3.0120	3.0167	+ 0.2
Outside diameter, in.	3.5560	3.5617	+ 0.2	3.4820	3.4847	+ 0.1
Wall thickness, in.	0.271	0.272	+ 0.4	0.235	0.234	- 0.4
Moisture content, %	7.6	7.6	0.0	8.1	8.2	+ 1.2

[a] Based on results "with liners" as reference.

[b] 36-inch span.

TABLE V (Cont'd.)

CORE STOCK PROPERTIES

Run No.	Modified Ring Compression, lb./in. M.D.	C.D.	60° to M.D.	30° to M.D.	Taber Stiffness, g.cm. M.D.	C.D.	Tearing Strength, g. M.D.	C.D.	TAPPI Plybond, p.s.i.g.	Porosity, sec./100 cc.	Water Drop, sec.[b]
1	50.0	24.8	29.1	38.5	684	148	348	488	114	62	584+
2	68.9	42.7	47.5	60.5	1031	272	560	771	167	228	129
3	61.0	34.1	39.1	48.4	854	194	500	694	153	131	64
4	48.2	26.7	30.8	39.0	570	136	351	516	127	62	252
5	42.0	19.9	23.8	30.4	360	86	242	343	109	63	410
6	54.9	31.8	36.0	45.7	546	133	392	594	137	126	600+
7	53.2	29.9	33.2	42.4	762	190	422	565	129	115	216
8	71.4	42.1	46.9	61.9	1027	255	499	665	177	132	113
9	68.0	39.7	44.6	56.0	828	242	556	769	145	115	36
10	54.7	32.6	36.5	43.4	739	197	409	580	144	165	388
11	42.0	30.6	31.5	34.6	419	190	285	318	110[a]	11	600+
12	48.4	26.4	31.6	40.4	743	178	402	535	132	102	600+
13	50.5	26.6	33.2	39.5	648	172	380	523	136	111	313
14	65.4	39.2	43.6	50.3	732	202	423	587	173	188	600+
15	56.8	29.1	35.6	43.4	750	194	472	629	131	50	28
16	60.0	33.8	41.8	49.0	929	245	572	712	139	60	24
17	56.2	36.3	40.3	45.4	556	182	317	428	163	91	600+
18	55.8	32.6	38.4	44.8	705	200	410	536	141	96	160
19	54.5	32.9	36.2	44.6	476	129	311	439	162	173	150
20	44.6	23.1	27.0	34.8	551	134	252	354	121	95	270+
21	42.0	25.8	31.0	37.0	512	176	322	445	139	72	50

[a] Contact cement was applied to plates and felt side of specimen because of rough surface.

[b] A plus sign indicates that time for one or more specimens exceeded 600 sec.

Core Sample Identities for Report One

Run No.	Company	Identification
1	John Strange Paper Company	0.030 Special Core Stock
2	John Strange Paper Company	0.030 Tufkor
3	John Strange Paper Company	0.030 Premium Core Stock
4	Sonoco Products Company	HTV 0.025 Duro Core Stock
5	Sonoco Products Company	Chip
6	Sonoco Products Company	HTV 0.025 Durolene
7	Fibreboard Corporation	0.030 Full Bending Chip, Low Bond
10	Fibreboard Corporation	0.030 Full Bending Chip, High Bond
8	Alton Box Board Company	0.030 X-Cel-E
15	Alton Box Board Company	0.030 TexRock
16	Alton Box Board Company	0.030 Jute
9	Container Corp. of America	0.030 Core Stock, Premium Grade Bond
11	International Paper Co.	0.030 ChemCore 20
17	International Paper Co.	0.030 Special Grade 0128
12	J. C. Baxter Company	0.030 RocCor 430
13	J. C. Baxter Company	0.030 RocCor 230
14	J. C. Baxter Company	0.030 RocCor 830
18	Star Paper Tube, Inc.	0.030 Jute
19	Star Paper Tube, Inc.	0.025 D Jute
20	Star Paper Tube, Inc.	0.030 Tubing Chip
21	Hoerner Waldorf Corp.	0.030 Tubing Chip

Core Sample Identities for Your Company:

Run No.	Identification